U.S. DEPARTMENT OF ENERGY | Fossil Energy and Carbon Management

ALASKA REGIONAL REPORT

Building A Clean Energy and Industrial Economy and the Supporting Role of the U.S. Department of Energy's Office of Fossil Energy and Carbon Management

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Contents

Purpose of this Report

The "**Alaska Regional Report: Building a Clean Energy Economy and the Supporting Role of the U.S. Department of Energy's Office of Fossil Energy and Carbon Management**" aims to deepen the understanding of the decarbonization opportunities and challenges in Alaska, supporting broader efforts to achieve a clean energy future. The report underscores Alaska's potential to capitalize on its geological storage and natural gas resources while diversifying its energy industry. It also highlights Alaska's potential in developing a domestic critical minerals supply chain given its abundance of resources, including copper, cobalt, lithium, and rare earth elements. Additionally, drawing from Alaska's energy plans and climate strategies, this report identifies priority areas for the state and aligns them with the research, development, and demonstration portfolio of the U.S. Department of Energy's (DOE's Office of Fossil Energy and Carbon Management (FECM) to curate relevant solutions.

This report was developed by the Office of Fossil Energy and Carbon Management in collaboration with the National Energy and Technology Laboratory (NETL).

This report is being disseminated by the Department of Energy. As such, this document was prepared in compliance with Section 515 of the Treasury and General Government Appropriations Act for Fiscal Year 2001 (Public Law 106-554) and information quality guidelines issued by the Department of Energy.

Introduction

The U.S. energy portfolio and economy currently depend heavily on fossil energy. However, it is crucial to advance clean energy solutions, such as carbon capture and storage, carbon dioxide removal, and other decarbonization pathways, to achieve a net-zero greenhouse gas emissions future. FECM is dedicated to minimizing the environmental and climate impacts of fossil fuels while working to achieve net-zero emissions across the U.S. economy. Its portfolio encompasses the research, development, demonstration, and deployment of technologies that include carbon capture, carbon conversion, carbon dioxide removal, carbon dioxide transport and storage, hydrogen production with carbon management, methane emissions reduction, and critical minerals production.

In addition to implementing this portfolio, FECM is engaging with communities and stakeholders across the country where significant project development is expected to occur to ensure community and stakeholder participation, understand and address concerns, and increase awareness regarding FECM funding and opportunities available. FECM focuses on two-way engagement, in which communities and stakeholders are not only informed, but they also have the opportunity provide input and shape the design and development of projects and infrastructure that affect them. This aligns with DOE's broader priority of placing stakeholders and local communities at the center of project development efforts, ensuring that DOE's investments result in tangible benefits for communities.

The Community Benefits Plan framework is one example of a significant initiative that aims to institutionalize this priority. This framework aims to ensure that projects receiving public funding, particularly from the Bipartisan Infrastructure Law and the Inflation Reduction Act, create economic, environmental, and societal benefits for the communities and workers where projects are located. Through close collaboration between developers and communities, Community Benefits Plans can evolve into Community Benefit Agreements, which are legally binding agreements between community groups and developers, stipulating the benefits a developer agrees to fund or furnish in exchange for community support of a project. DOE does not require Community Benefit Agreements but encourages them as an outcome of developing a Community Benefit Plan. Ideally, strong Community Benefit Plans result in formal agreements to create lasting benefits that will continue after DOE's involvement in a project ends

As outlined throughout this report, FECM's focus areas and portfolio of technologies are well-aligned with Alaska's energy mix, local infrastructure, and resources. These efforts will also help the region engage communities, create new jobs, build new supply chains and industry, and invest in supporting university research and development and innovation. Further, through DOE's Community Benefit Plans and Community Benefit Agreements, FECM illustrates how the design and scope of a project can maximize economic, environmental, and societal benefits for communities in the state, contributing to project success.

Alaska—An Energy Producing State with a Long History of Sustainability

"Resource rich, vast, diverse, young, exporter, in benefit of its people and future generations"

(The Alaska Standard published by Governor Mike Dunleavy).

In 2023, the Governor's Office published the Alaska Standard, an inaugural sustainability report that documents the history and development of Alaska's oil, natural gas, and critical mineral resources. Alaska was an early mover in implementing practices to manage the environmental impact of its energy operations. It was the first state, starting in 1971, to regulate and prohibit flaring in oil and natural gas operations and is ranked the lowest in total energy related carbon dioxide emissions among major oil and gas producing states.[1] Alaska has the second largest proved natural gas reserves and is the fifth largest crude producer and the fourth largest natural gas producer in the United States.[2] Further, the oil industry accounts for one quarter of the state's employment, and tax and royalty income from the oil and gas industry has accounted for up to 90% of the state's unrestricted general fund revenues, totaling over $155 billion in state revenue since statehood.[3]

However, since there is no pipeline infrastructure to transport the natural gas produced in the North Slope to consumers, this natural gas (approximately 90% of the natural gas produced) is re-injected and used to maintain reservoir pressure for oil production instead of being brought to market.[4] The Alaska Liquefied Natural Gas (LNG) Project[5] would, if developed, allow natural gas to be produced from standard resources on the North Slope and transported using a proposed 800-mile long pipeline natural gas from the North Slope to southern Alaska for liquefaction and export. Additionally, this Project would enable the development of interconnections along the pipeline route, providing Alaskans access to natural gas for heat and electricity generation. Currently, the lack of energy infrastructure means that many rural communities rely on diesel for the local generation of electricity. As a result, natural gas and electricity bills can be up to 33% higher than the national average. Additionally, some areas face local air quality issues due to the use of coal, wood, and oil for heat. For example, Fairbanks, in the central interior region of Alaska, does not meet U.S. Environmental Protection Agency (EPA) air quality standards. EPA has determined that Fairbanks is a serious non-attainment area for particulate matter (PM 2.5) with pollution levels high enough to be a human health concern.[6]

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[1] The Alaska Standard

[2] U.S. Energy Information Administration - this is in natural gas withdrawals, produced with oil, as only about 10% of the natural gas is marketed

[3] The Alaska Standard

[4] U.S. Energy Information Administration

[5] Alaska LNG - Alaska Gasline Development Corporation | Alaska Liquified Natural Gas

[6] The Alaska Standard

The mining industry has a significant role in Alaska's economy, providing employment for approximately 11,400 direct and indirect jobs in 2022.[7] Alaska is home to 49 of the 50 federally-designated critical minerals, including graphite, cobalt, and rare earths, which are essential for clean energy technology and U.S. national defense.[8] Additionally, Alaska leads in U.S. zinc production, is a major producer of gold, and produces gemstones, construction sand and gravel, crushed stone, lead, and silver.[9] Notably, the state has significant coal reserves with deposits of bituminous coal, subbituminous coal, and lignite found in the north, south, and central portions of the state.

Alaska has a history of using the proceeds from its energy industry to support the economic and social development of its people. Alaska Natives and American Indians make up almost 15% of the state's population, and Alaska has 12 regional corporations that represent 229 tribal groups, which form an integral part of the energy and mining workforce. For example, the Red Dog Mine is the second largest producer of zinc in the world, and Alaska Natives comprise over 60% of its workforce. Alaska Natives have a significant influence on the state's approach to resource development.[10] However, the state is significantly impacted by climate change, evidenced by an average temperature increase of approximately three degrees Fahrenheit over the past 60 years, twice that of the rest of the United States. This temperature increase is disproportionately impacting subsistence lifestyles for many rural Native Alaskans.

To ensure responsible resource development, mitigate the impacts of climate change in the Arctic region, and protect traditional native practices, the Arctic Slope communities formed The Voice in 2015. The Voice is comprised of the region's Iñupiat leadership, who collectively represent the Arctic Slope communities on issues that impact them, such as regional resource development and subsistence hunting.[11]

Alaska's future will continue to be inextricably linked to how it develops and exports its natural resources and investment in infrastructure to pursue new opportunities (e.g., carbon dioxide (CO_2) storage, LNG export, clean hydrogen/ammonia export, and critical mineral mining) and to provide access to affordable electricity to rural communities and the mining industry. Although the current overall energy mix of Alaska is 98% fossil fuels, the state is working to increase the share of renewables in its electricity mix and to extend access to rural communities.[12] In 2023, to help strengthen Alaska's electricity grid, DOE's Grid Deployment Office awarded Alaska Energy Authority a $206.5 million grant to support broader efforts to improve the resilience of the power system and enhance grid flexibility.[13]

[7] Economic Benefits | Alaska Miners

[8] Alaska Clean Energy Week

[9] The Mineral Industry of Alaska | U.S. Geological Survey

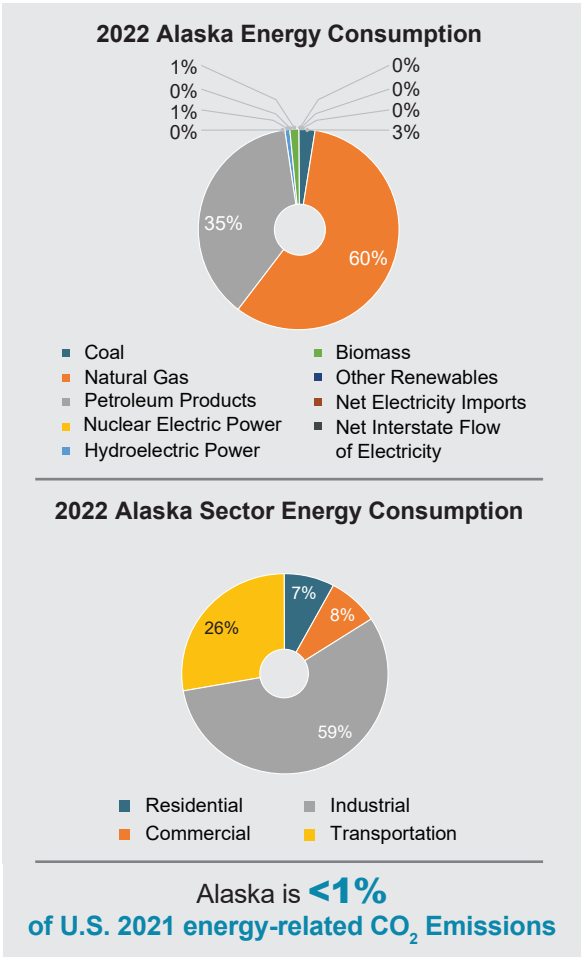
[10] Alaska Clean Energy Week

[11] The Alaska Standard

[12] The Alaska Standard

[13] $206 Million Federal Grant Will Strengthen Alaska's Electrical Grid Resilience - Alaska Business Magazine

Figure 1: Energy in Alaska



98%
Of 2022 energy mix is fossil energy with natural gas and petroleum products making up 95%. No nuclear and about 2% renewables

59%
Of 2022 energy consumption is industrial primarily from the oil and natural gas industry with the oil industry accounting for 1/4 of the state's employment

23%
Of 2023 electricity mix was from renewables, primary hydropower (21%) and wind and biomass less than 2%

12
regional native corporations encompassing 229 tribal groups own almost all of Alaska's tribal land (11% of Alaska's total land area)

49/50
Critical minerals, including graphite, colbalt, and rare earths

#1
Largest carbon storage potential on the U.S. West Coast

4th
Largest proved crude oil reserves and in oil production

Source: EIA. Energy consumption (also referred to as energy mix) includes fuels consumed. Electricity mix includes electricity generated from fossil, nuclear, and renewable plants. See EIA glossary. Glossary - U.S. Energy Information Administration (EIA)

Even in the most optimistic scenario for renewable energy development, significant reliance on fossil energy in the near- to medium-term is probable. As a result, carbon management is crucial to Alaska's decarbonization efforts, and many opportunities exist. For example, Alaska could have the largest potential CO_2 storage resources along the West Coast of the United States.[14] Additionally, its proximity to the West Coast and Asia, coupled with established oil trade routes, creates opportunities for exporting clean hydrogen (in the form of ammonia) and importing CO_2 emissions captured in other markets for geologic storage in Alaska.

The Bipartisan Infrastructure Law and the Inflation Reduction Act also established a historic policy framework that, through federal funding, financing, and tax credits, is helping to enable a robust market for clean energy and industrial projects. This framework includes tax credits that support the financing of projects in the carbon management and critical minerals industries, offering significant support to Alaska's development. For example, the federal 45Q tax credit provides up to $85 per metric ton of CO_2 captured from industry and power generation for dedicated storage in geologic formations and $60 per metric ton of CO_2 captured and

[14] The Alaska Standard

geologically stored through the process of enhanced oil recovery. Enhancements to the tax credit also include: an authorization of the credit for a full ten years (i.e., all projects beginning construction by the end of 2032 are eligible); the ability to claim the credit for 12 years of operation, directly as a cash payment for the first five years of operation, and the option to transfer the credit to outside investors for the remaining seven years; and expanded eligibility for smaller industrial, power generation, and direct air capture facilities. For critical minerals, 45X tax credit provides a 10% credit for the production of 50 different minerals that are essential to our clean energy economy and national security. For clean hydrogen, 45V tax credit creates a new 10-year incentive for clean hydrogen production of up to $3.00/kilogram. The level of the credit provided is based on carbon intensity (i.e., the lower the carbon intensity, the higher the credit), with a maximum of four kilograms of CO_2-equivalent per kilogram of hydrogen eligible for the tax credit. Additionally, funding and financing fromDOE's Loan Programs Office further contribute to a robust economic environment for the development and financing of clean energy and industrial projects and infrastructure.

Alaska is now entering the next chapter of its evolution. From advancing industry innovation to creating highwage jobs and bringing other benefits to local communities and native Alaskans, the state is poised to have a key role in helping the United States advance toward a secure and net-zero emissions future. The Arctic Energy Office, DOE's only regional office, works closely with FECM and other offices to raise awareness of Alaska equities and DOE opportunities in the efforts described in this report.

Future Low Carbon Energy and CO_2 Trade

With CO_2 storage, Alaska has an opportunity to reduce power sector and industry emissions and expand its energy trade.

FECM is currently working with organizations in Alaska to develop CO_2 storage opportunities. In November 2023, the University of Alaska Fairbanks was one of sixteen projects selected to receive a total of $444 million to support the development of new and expanded large-scale, commercial carbon storage projects, each with the capacity to securely store 50 or more million metric tons of CO_2 over a 30-year period. All projects will support DOE's Carbon Storage Assurance Facility Enterprise (CarbonSAFE) Initiative. The University of Alaska Fairbanks will evaluate the suitability of a CO_2 storage complex for storing power plant emissions in the northern Cook Inlet Basin of south-central Alaska.

The availability of CO_2 storage is an opportunity for the refineries and power plants that are clustered together in the north, middle, and south of Alaska to share carbon management infrastructure and reduce their emission footprints. Additionally, CO_2 storage, coupled with carbon capture, is critical if coal or natural gas is to be used for power generation in the future. Alaska has significant coal reserves, but there is only one mine and coalpower accounts for only 11% of the electricity mix. Today, approximately half of electricity is generated from natural gas, yet the Cook Inlet, Alaska's most populous area, is expected to face natural gas shortages before 2030. There are multiple efforts to address this looming shortage, including expanding natural gas exploration in the area and expanding renewables.[15] Increasing renewable electricity is an important focus, and just over 20% of Alaska's electricity is hydropower. Wind currently represents 2% of Alaska's electricity and growing, while efforts to harness tidal and ocean technologies are being explored. However, it is unlikely that either renewables expansion or micronuclear power (which is also being explored) will be able to meet the volume of electricity and timeline required given the infrastructure that would be required to develop and connect these distributed resources and the expected near-term depletion of Cook Inlet natural gas.[16]

There are also opportunities to deploy direct air capture with CO_2 storage, which is a form of carbon dioxide removal, in Alaska. In August 2023, DOE selected ASRC Energy Services, LLC to receive $3 million in DOE fundingto conduct a pre-feasibility study that will evaluate direct air capture locations in the North Slope, the Interior (Fairbanks), and Southcentral (Anchorage, Kenai Peninsula, and Mat-Su), as well as review the operating range of existing technologies to identify modifications required to operate in the Arctic. This effort is a part of a broader DOE investment in advancing commercial-scale direct air capture facilities across the nation. Similar to the incentives for industry and power described previously, there are incentives available in the 45Q tax credit to leverage storage opportunities for direct air capture projects. These incentives include credit values of up to $180 per metric ton for direct air capture facilities with dedicated storage in geologic formations and $130 per ton of CO_2 captured and geologically stored through the process of enhanced oil recovery.

[15] Lawmakers aim numerous bills at alleviating Southcentral Alaska's natural gas supply crunch: Alaska Beacon

[16] The Alaska Standard.pdf

In addition to supporting the decarbonization of domestic energy use and deploying direct air capture, Alaska's strategic location, with its proximity and established shipping routes to Asia and the West Coast, positions the state well to serve as a CO_2 storage hub. During Japan's official visit to the United States in April 2024, both nations committed to evaluating the potential for cross-border CO_2 transport and storage hubs between Alaska and Japan.[17]

Carbon storage is also important for the proposed Alaska LNG Project since the oil produced in the North Slope has significant associated natural gas that is rich in CO_2. This CO_2 could be separated from the produced gas and used for enhanced oil recovery or it could be geologically stored. The treated natural gas would then be transported by pipeline to southern Alaska. If the proposed Alaska LNG Project is developed, the natural gas pipeline could supply natural gas to produce clean hydrogen/ammonia, with carbon storage in the Cook Inlet.[18] However, the Alaska LNG Project faces a number of challenges, including higher costs relative to LNG projects in the lower-48 states, reflecting the need for a long pipeline from the North Slope though the interior to the south. There is also the inherent difficulty of constructing a large infrastructure project in Alaska, given the need for materials to be imported and limited construction periods throughout the year.[19] Additionally, there are currently no long-term offtake contracts associated with the Project.

However, the opportunity for clean hydrogen in the form of ammonia to be exported from the U.S. to markets like Japan is being investigated. In Japan, one of world's largest thermal generators publicly announced its strategy to procure ammonia from the United States and a joint development agreement to explore the development of ammonia production capacity for export to Japan from Louisiana.[20, 21] The Alaska Gasline Development Corporation, Japan's Mitsubishi Corp, TOYO Engineering Corp, and Hilcorp Alaska are evaluating the commercial feasibility of utilizing North Slope natural gas delivered to Southcentral Alaska via the proposed Alaska LNG Project to produce ammonia and to store the byproduct CO_2 in the Cook Inlet Basin.[22] Ammonia production in Alaska, using natural gas from the North Slope, would require the development and evaluation of multiple network options (one of which would be the natural gas pipeline from the North Slope to the Cook Inlet mentioned previously) for the production, transport, and storage of natural gas, clean hydrogen/ammonia, and CO_2. Similar to the Alaska LNG Project, there would also be significant technical, financial, and commercial factors to consider as it relates to subsequent construction.

Another consideration for the development of this potential infrastructure is public support. To realize the full potential of these opportunities in Alaska, engagement with communities, and in particular Alaska Natives, and other impacted stakeholders will be critical. Through FECM's University Training and Research program, the University of Alaska, Fairbanks will carry out a public research campaign to understand the benefit of transforming the Trans-Alaska Pipeline System into a multifunctional asset that can efficiently distribute clean hydrogen across Alaska.

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[17] Fact Sheet: Japan Official Visit with State Dinner to the United States: The White House

[18] Project Selections for FOA 2711: Carbon Storage Validation and Testing (Round 2): U.S. Department of Energy

[19] See DOE/FE Order No. 3643-A Final Opinion and Order Granting Long-Term Authorization to Export Liquefied Natural Gas to Non-Free Trade Agreements Nations, at 15 ("Alaska LNG states that this 'integrated mega-project' is unique due to its size, scope, costs, required upstream development, and project development timeline, which are more significant than any LNG project in the lower-48 states.").

[20] The Zero-Emission Promise of Ammonia: DISCOVER JERA

[21] CF Industries and JERA Announce JDA to Develop Greenfield Low-Carbon Ammonia Production Capacity in U.S. | CF Industries

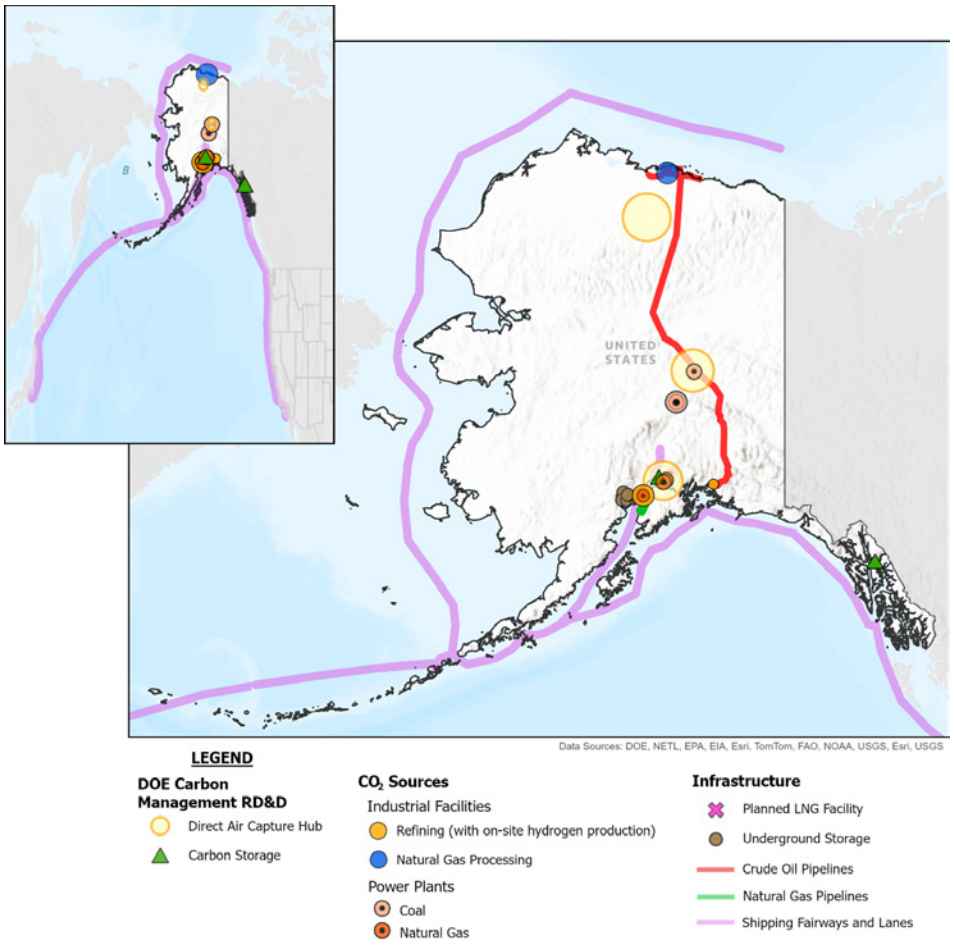
[22] Japan Companies to Study Making Ammonia from Artic Alaska Gas: Arctic Today

Regarding CO_2 storage specifically, the Alaska Department of Natural Resources, which was awarded funding under FECM's Regional Initiative Program, plans to establish a foundation for carbon capture and storage by addressing technical challenges, environmental factors, and stakeholder engagement to meet the need for development of an offshore hub in the Cook Inlet region of Alaska. The project will support the safe and socially equitable deployment of carbon capture and storage by offering technical and community support services and information sharing to stakeholders. To support these goals, the project is enhancing geologic data gathering, analysis, and sharing in areas of Alaska where individual hub-scale storage facilities are likely to emerge.

If infrastructure projects progress with federal funding, DOE's Community Benefit Plan framework will ensure that stakeholder engagement centers on designing projects that maximize economic, environmental, and societal benefits for host communities. Developers whose projects proceed without federal funding can refer to FECM's "Responsible Carbon Management Initiative" as a guide for how to pursue the highest levels of safety, environmental stewardship, transparency, and community engagement and benefits in project development.

Map 1: Alaska Energy Trade

Alaska's energy trade routes and proximity to Asia could be leveraged to export LNG and clean hydrogen/ammonia and to import CO_2.



Source: National Energy and Technology Lab (NETL) Research & Innovation Center (RIC). Developed using publicly available data sources (EPA, USGS, etc.).

Technology to Reduce the Emissions of Alaska's Oil and Natural Gas Operations

Technology to measure and reduce emissions and to increase the sustainability of operations is critical for Alaska as it continues to develop its oil and natural gas resources for the benefit of its people and future generations.

Alaska's oversight of its oil and gas operations is already more stringent than federal regulations in the areas of flaring, spill control, spill prevention, oil discharge, and spill reporting on land and water.[23] 98% of Alaska's natural gas production is associated with oil production and only 10% of that production is marketed for commercial use. Because this gas is stranded, with no commercial outlet, it is critical to ensure that emissions from production are minimized.

Table 1: Natural Gas in Alaska (2022)

Natural Proved Gas Reserves	2nd in the United States
Natural Gas Withdrawals (primarily reinjected back into oil reservoirs)	4th largest in the United States
Natural Gas Withdrawals from Oil Wells	98%
Natural Gas Marketed	10%

Source: U.S. Energy Information Administration

There are two FECM program areas that can support this objective. Aligned with the Biden-Harris Administration's U.S. Methane Emissions Reduction Action Plan, which reflects an overall global goal to cut methane emissions by 30% from 2020 levels by 2030, FECM is leading an international effort on the development of a global measurement, monitoring, reporting, and verification (MMRV) framework. This framework aim to advance comparable and reliable information about greenhouse gas emissions across the natural gas supply chain to drive global emission reductions. Additionally, FECM's Methane Mitigation Technologies Program focuses on achieving near-elimination of emissions from the oil and gas supply chain by 2030—from production to processing, transportation, storage, and end use—including materials, equipment, and processes to enable currently flared, vented, or otherwise stranded natural gas to be converted to products with a higher market value.

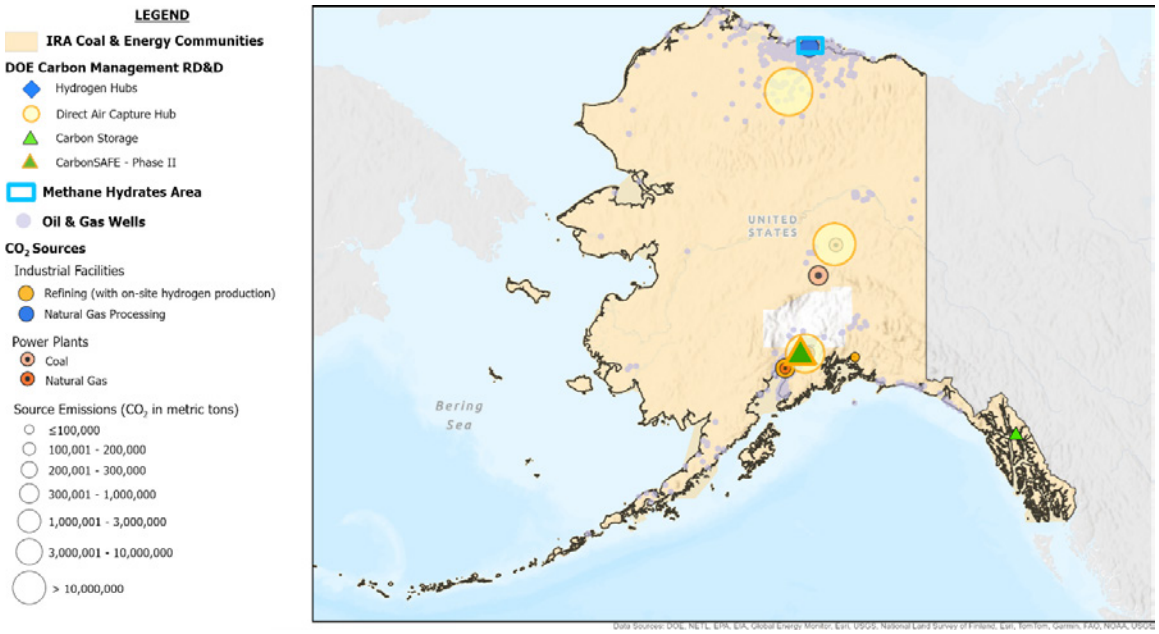
As a part of the Methane Mitigation Technologies Program, FECM is working with EPA to implement $1.36 billion in technical and financial assistance through the Methane Emissions Reduction Program that was established under the Inflation Reduction Act to target methane emissions across the oil and natural gas supply chain. The program will provide funding to measure emissions and to voluntarily plug high emitting marginal wells, as well as providing financial assistance for installing equipment to reduce emissions from equipment such as valves, tanks, and compressors. This could be an opportunity for the legacy wells in the North Slope that have yet to be remediated or are out of compliance with state regulations.[24]

[23] The Alaska Standard

[24] The Alaska Standard

Map 2: Energy Infrastructure and Resources

Alaska takes pride in having the lowest total state energy-related CO_2 emissions of a petroleum-producing state, and technology will be critical to maintaining this position and unlocking the economic opportunities of Alaska's oil, gas, and storage resources.



Source: National Energy and Technology Lab (NETL) Research & Innovation Center (RIC). Developed using publicly available data sources (EPA, USGS, etc.).

Further, improving the sustainability of oil production is more critical now than ever before. FECM is funding efforts to advance the treatment and beneficial reuse of produced water for non-consumptive applications like industrial applications-as well as for reducing the risk of induced seismicity associated with deep water disposal. FECM is adding Alaska to its characterization efforts to better understand this opportunity in the state.

In addition to the natural gas produced today through conventional or shale wells, Alaska has methane hydrates in accessible geologic formations on the North Slope. Methane hydrates, or gas hydrates, are cage-like lattices of water molecules containing methane. The potential resource of methane hydrates in the North Slope is almost 54 trillion cubic feet, equivalent to about 8.6% of total U.S. proven natural gas reserves. However, methane hydrates are not commercially viable, as producing natural gas from these systems is not fully understood and there is ample availability of natural gas produced through current methods. Additionally, the warming of arctic sediments or ocean waters could cause methane hydrate to dissociate, releasing methane into the deepwater sediments, the ocean, or atmosphere.

DOE is partially funding a methane hydrates production test involving a long-term production experiment (i.e., hydrate reservoir response to depressurization) on the Alaska North Slope, in partnership with the government of Japan, private industry, the U.S. Geological Survey, and the Alaska Department of Natural Resources. The objective of this project is to advance the science of hydrates to understand the conditions that lead to hydrate dissociation. Results from this test will improve our fundamental understanding of both the behavior of these potentially large gas hydrate deposits and the effects of climate change (e.g., degas) on the stability of these systems.

Recovery of Critical Minerals

Alaska is rich in critical minerals with mining as a core sector and growth engine, but there is a further opportunity to recover critical minerals from byproducts and waste streams of hard rock mines and from coal, coal byproducts, and coal wastes.

Alaska is well positioned to have a key role in developing a domestic supply of critical minerals and rare earth elements, which are key to manufacturing clean energy technologies—such as solar panels, wind turbines, electric vehicles, and hydrogen fuel cells—that will help the United States achieve a net-zero emissions economy. They are also essential to the manufacture of technologies and products vital to national security. Demand for critical minerals and rare earth elements is growing, and the United States currently imports greater than 80 percent of its rare earth elements from non-domestic suppliers.

There is significant opportunity in Alaska to build a secure, sustainable domestic supply of critical minerals from a broad range of sources. For example, Alaska has an abundance of the critical minerals including copper, cobalt, lithium, and rare earth elements needed for electrification, ranging from the Red Dog Mine, the Ambler Mining District for cobalt and copper, through to the Graphite Creek deposit north of Nome and rare earth deposits on Prince of Wales Island.[25] Alaska's substantial mining history has also resulted in millions of tons of tailing piles that contain these valuable minerals, offering a potential additional resource. Additionally, there is an opportunity to remediate the tailing piles and other mining wastes and their legacy environmental and community impacts in the process.

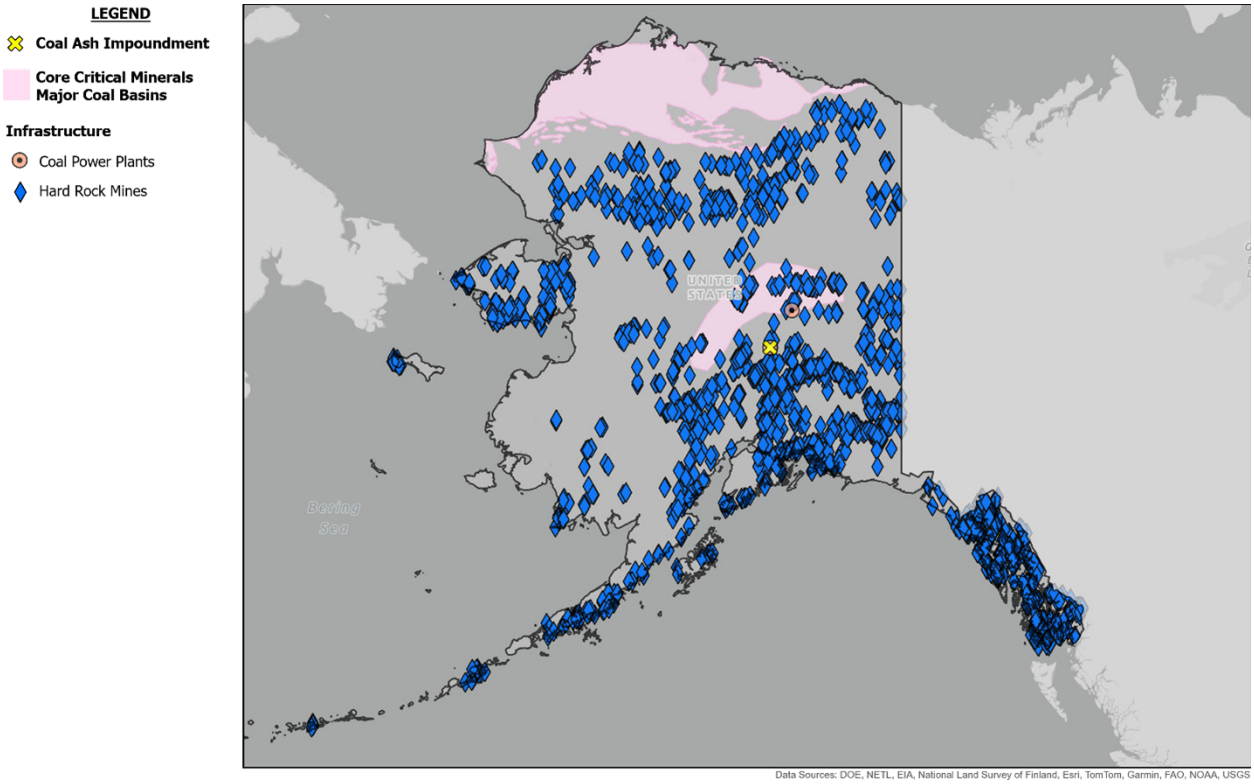
Furthermore, as metal mining continues (e.g., for copper and zinc), there are opportunities to recover and process other critical material byproducts (e.g., cobalt and rare earths) that were previously discarded as waste. Although these materials have relatively low concentrations of rare earth elements and critical minerals, their accessibility after being brought up from the subsurface often makes them economically viable. This allows for more mineral recovery without the need for extensive new mining activities. Additionally, rare earth elements and other critical minerals can be found in the coal that is currently being mined in the region.

Together, these opportunities make Alaska a strong potential resource to underpin the development of domestic supply chains to help reduce America's dependence on other countries for these critical minerals, create goodpaying jobs, and support communities that historically have depended on mining and energy production. But this opportunity is predicated on infrastructure development to access the mining sites, as well as the availability of affordable and preferably low carbon, electricity.

[25] The Alaska Standard

Map 3: Critical Elements and Rare Earth Elements Potential

Alaska has the opportunity to produce rare earth elements and critical minerals from the waste and byproducts of its hard rock mines and coal, coal byproducts, and coal waste.



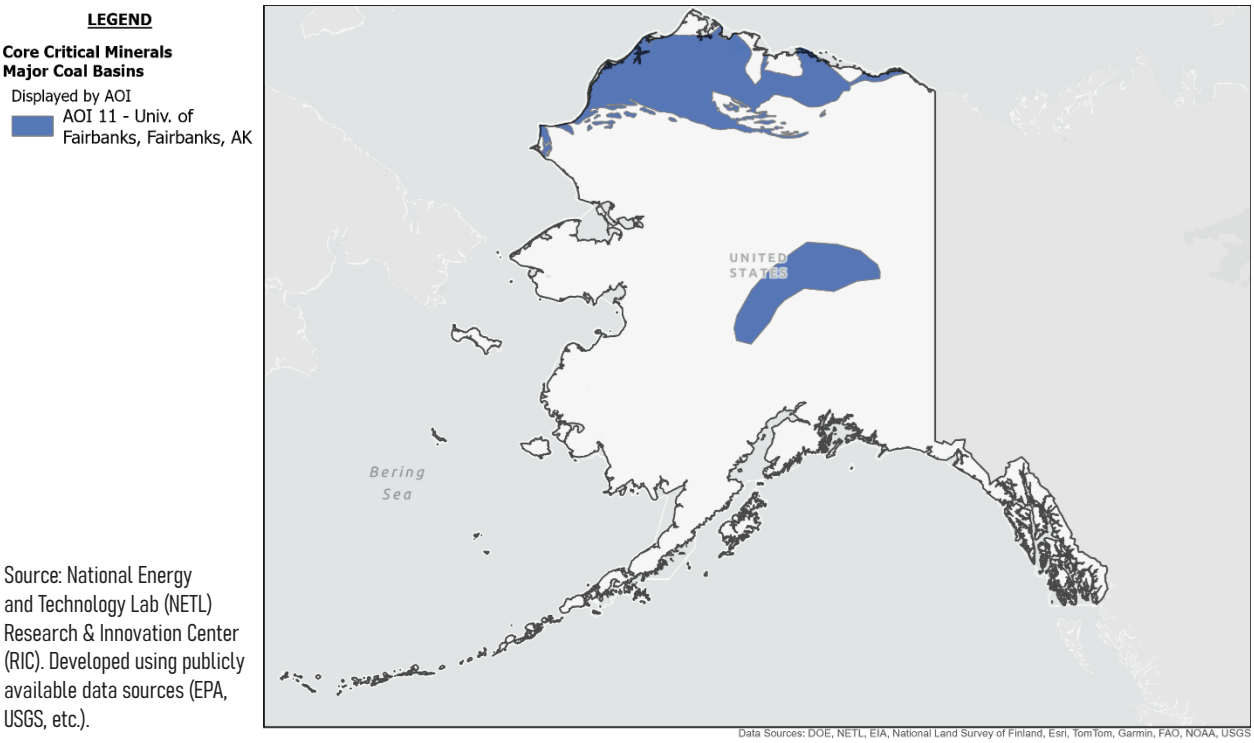
Source: National Energy and Technology Lab (NETL) Research & Innovation Center (RIC). Developed using publicly available data sources (EPA, USGS, etc.).

For the past decade, FECM and DOE's National Energy Technology Laboratory have pursued research and development activities to advance technologies that produce rare earth elements and critical minerals from unconventional feedstocks while remediating land and water impacted by these energy and mining byproducts and wastes (e.g., coal, coal ash, acid mine drainage, and produced water). FECM's Carbon Ore Rare Earth and Critical Minerals (CORE-CM) Initiative brings together coalitions of universities, industry, state agencies, and others to provide assessments of these feedstocks in coal basins across the country.

In 2021, the University of Alaska was awarded financial assistance to lead one of 13 basinal CORE-CM coalitions to research the opportunity to reduce our nation's reliance on imported rare earth elements and critical minerals by establishing Alaska's resources as competitive sources of supply. The University of Alaska has documented encouraging rare earth element and critical mineral concentrations in preliminary studies of coal at two sites. This project will systematically perform a set of broad basinal assessments of Alaska's carbon ores, rare earth elements, and critical minerals found in several of Alaska's basins. Included in the analysis are Alaska's only operating coal mine and the basin hosting North America's largest large-flake graphite deposit. The team will also investigate opportunities to create high-value, non-fuel carbon products from coal in basins associated with rare earth element and critical mineral resources to increase their economic potential.

Throughout this analysis, Alaska's unique challenges are being considered and opportunities to remove or reduce barriers are being addressed. For example, 80% of Alaska is without roads, and an even greater area does not have access to the only power grid in the state, which primarily connects Fairbanks to Anchorage. The team must consider factors in addition to mineral content within a basin and will devise a priority matrix for ranking basins across the state. Final rankings will consider the quality of the CORE-CM content, access to infrastructure or ability to build it, readiness of technology to exploit the resource in that location, environmental factors, and market potential.

Map 4: CORE-CM Coalitions in Alaska



Source: National Energy and Technology Lab (NETL) Research & Innovation Center (RIC). Developed using publicly available data sources (EPA, USGS, etc.).

Additionally, FECM is establishing an Advanced Critical Materials Extraction Program that will develop novel technologies that will revolutionize mining in a way that significantly reduces the environmental impacts and associated costs of mining. These technologies including advances in geophysics, drilling, artificial intelligence and machine learning, robotics and automated systems, in situ extraction and processing technologies, improved tailings management, and material traceability. The goal of these efforts is to bring a more surgical approach to mining that significantly reduces the ratio of waste to metal brought out of the ground, the amount of water used, the energy needed, the associated greenhouse gas emissions, and the overall emissions to land, water, and air. This research should help improve the impacts of mining to the surrounding communities, which should improve the social license to mine, which in turn, is expected to impact domestic mining and associated permitting times in a positive way.

This is an opportunity to help bring a new industry of critical mineral recovery, processing, and refining to the region, finding new higher-value, non-combustion uses for coal, as well as for coal wastes and other energy and mining wastes and helping to remediate those wastes and their legacy environmental and community impacts in the process.

Spotlight on Investment and Support in the Alaska Region

FECM has a growing presence in Alaska and is working with the region to develop and advance technologies and protocols in carbon management and resource sustainability. There are five main activity areas with a total project value of $74 million.

Projects include:

- **Alaska Railbelt Carbon Capture and Storage Project**: The University of Alaska Fairbanks intends to determine the feasibility of developing a commercial-scale CO_2 geologic storage complex to store more than 50 million metric tons of CO_2 safely and economically in south-central Alaska (northern Cook Inlet Basin) with a depleted unitized gas field as the primary CO_2 storage horizon.
- **Alaska Carbon Capture, Utilization, and Storage Database**: he Alaska Department of Natural Resources plans to assess and provide pertinent data to an emerging carbon management industry with the goal of accelerating the development and implementation of CO_2 storage within the Cook Inlet Region of Alaska.
- **Regional Direct Air Capture Hub**: ASRC Energy Services, LLC will conduct a pre-feasibility study that evaluates direct air capture locations across Alaska and will review the operating range of existing technologies to identify modifications required to operate in the Arctic.
- **CORE-CM**: The University of Alaska and partners will perform a set of broad basinal assessments of Alaska's carbon ores, rare earth elements, and critical minerals. Included in the analysis will be two obvious basins: (1) that hosting Alaska's only operating coal mine, and (2) the basin hosting North America's largest large-flake graphite deposit. These efforts support the evaluation of Alaska's resources as competitive sources of supply of critical minerals and the opportunities to create high-value, non-fuel products from carbon ores.
- **Methane Hydrates**: DOE's Gas Hydrates Research and Development Program aims to advance the scientific understanding of gas hydrates as they occur in nature so their resource potential and role in climate change can be fully understood. As a part of these efforts, the program supports the evaluation of Alaska's methane hydrates resources, which include monitoring well services related to the maintenance, data collection, and abandonment of an existing stratigraphic test well. This is in addition to evaluating services related to the temporary storage, hauling, and permanent disposal of produced water from up to two production test wells.

Conclusion

A robust framework of federal funding, financing, and incentives made possible by the Bipartisan Infrastructure Law and Inflation Reduction Act lays the groundwork for significant clean energy and industrial investment in Alaska and creates exciting opportunities for the state's communities, workers, and businesses. As Asia and the West Coast of the United States move toward decarbonizing energy and emissions-intensive industries, Alaska stands poised to capitalize on its location and geological storage, with the opportunity to diversify its energy industry to include geologic storage services. Additionally, Alaska's abundance of critical minerals, including copper, cobalt, lithium, and rare earth elements, position the state as a crucial player in developing a domestic critical minerals supply chain that is essential for electrification, other clean energy and industrial technologies, and the nation's defense.

FECM is committed to supporting opportunities in Alaska to leverage its extraordinary natural resources and existing oil and natural gas and mining industries and experienced workforce to turn challenges into new economic opportunities, build clean energy and domestic critical mineral supply chains, and sustain and create new jobs.

The Alaska Regional Report is one of six regional reports that highlight resource sustainability and decarbonization solutions in fossil energy-producing and industrial regions. Given the rapidly evolving market, technology, and policy environment, the regional reports are intended to be "living documents" and will be updated as the outlook on each region evolves. Please note these reports and regional decarbonization workshops do not represent DOE policy or strategy, but rather are a representation of DOE's current understanding based on a synthesis of available facts.

FECM welcomes input and feedback on content for each of the reports. Please direct all inquiries and input to FECMRegionalReport@hq.doe.gov. Input and feedback should not include business-sensitive information, trade secrets, proprietary, or otherwise confidential information. Please note that input and feedback provided is subject to the Freedom of Information Act.

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